

May 23, 1986

CD-86-10 (LD)

Dear Manufacturer:

Subject: Alternative Methods for Establishing Coastdown Match
Times and Dynamometer Power Absorber Values

Enclosed is a request from Chrysler and EPA's response that we believe could be of general interest to all manufacturers. Chrysler's letter describes a specific method for analytically adjusting coastdown match times which they proposed to use beginning with the 1988 model year. Our response grants them conditional approval to use the values generated by their procedure.

We are providing this information to the industry as an example of an alternative approach to establishing coastdown match times and/or dynamometer power absorber (DPA) values. Any questions or requests for use of an alternative method to establish times or DPA values should be directed to your certification team.

Sincerely yours,

Robert E. Maxwell, Director
Certification Division
Office of Mobile Sources

Enclosure

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

ANN ARBOR, MICHIGAN 48105

April 15, 1986

Mr. Peter P. Sandretto, Jr., Supervisor
Emission Vehicle and Data Management
Certification and Regulatory Programs
Chrysler Corporation
P.O. Box 1118
Detroit, MI 48288

Dear Mr. Sandretto:

In your letter to us of February 11, 1986, entitled "Mass Correction Procedure for 1988 Model Year," Chrysler outlined a mass correction procedure to adjust coastdown match times generated at the heaviest equivalent test weight (ETW) for application at lighter ETW classes. The proposed procedure includes a method of accounting for tire rolling resistance changes, which Chrysler claims is more accurate than a simple mass correction of quick-check times and would avoid the expense of running actual coastdown tests at every ETW.

It is the manufacturer's responsibility to ensure that any vehicle within a coastdown group will meet the confirmatory test criteria in OMS Advisory Circular No. 55B. EPA will accept match times and dynamometer power absorption (DPA) values determined by any reasonable approach as long as confirmatory checks show the results to be accurate for all the vehicles they are applied to.

We have reviewed your proposal in detail and, given that your assumptions are correct, believe it to be a reasonable approach. You may use it at your option. However, continued use of this proposal will be contingent upon acceptable confirmatory test results.

I trust this adequately defines our position on this matter. Should you have any questions, please contact me.

Sincerely yours,

Original signed by

Bernard R. Patok
Certification Branch
Certification Division
Office of Mobile Sources

Proving Grounds
Engineering Office

CHRYSLER
CORPORATION

February 11, 1986

Mr. B. Patok, Team Leader
Certification Division
Mobile Source Air Pollution Control
Environmental Protection Agency
2565 Plymouth Road
Ann Arbor, Michigan 48105

Dear Mr. Patok:

RE: Mass Correction Procedure For 1988 Model Year

Chrysler currently submits its coastdown match time and horsepower for only the heaviest dynamometer equivalent test weight (ETW) class for each available vehicle and tire configuration. The data is then applied to lighter ETW classes for each vehicle and tire configuration. This method of grouping has resulted a considerable cost saving by reducing the number of coastdown tests needed to develop Chrysler's coastdown data submission.

The recent E.P.A. practice of directly mass correcting coastdown time data, and applying pass/fail criteria to mass corrected quick check times, now makes it necessary to develop a procedure to more accurately adjust coastdown submittal times for the lighter ETW classes. One method would be to simply run more tests, but this would result in an impractical and unnecessary increase in test time and cost. The broad guideline for coastdown data groupings are clearly stated in Section V, Paragraph B, of OMSAPC Advisory Circular, A/C No. 55B. Briefly, if tested, any member of a grouped population must be confirmed according to the acceptance criteria in Section VII of A/C 55B. It is in this spirit that the Chrysler mass correction procedure is proposed for the 1988 model year.

Chrysler's proposed mass correction procedure is attached to this letter. A timely response to our request would be appreciated to allow us to proceed with our 1988 plans. If needed, we are available to meet with you to further explain our proposal. If you have any questions please feel free to call me at 475-8651.

Very truly yours,

Chrysler Motors Corporation

Peter P. Sandretto, Jr., Supervisor
Emission Vehicle and Data Management

Certification and Regulatory Programs

mml

Attachment

cc: G. E. Allardyce
F. E. Allen
E. W. Beckman
J. D. Davis

A. J. DeJong
C. W. Essman
D. J. Gasser
H. B. Padgham

CHELSEA, MICHIGAN 48118

PROPOSED CHRYSLER MASS -CORRECTION PROCEDURE

Chrysler coastdown data submittals currently list match time and horsepower setting information for only the heaviest dynamometer equivalent test weight (ETW) class representing each available vehicle and tire configuration. Since, by definition, the submitted horsepower settings can also be considered representative of the lighter ETW classes, this practice has resulted in considerable time, cost, and simplification advantages for all involved parties. The recent E.P.A. policy of directly mass-correcting coastdown time data as part of the dynamometer confirmation test, however, has made it necessary to develop a procedure to accurately adjust coastdown submittal times to represent the lighter ETW classes.

One method of accounting for multiple ETW classes would be to conduct road and rolls coastdown tests at each of the available weights. This, of course, would result in an impractical and unnecessary increase in test time and cost. In E.P.A. Advisory Circular No. 55B (Section V, B.), the broad guidelines for coastdown data grouping are clearly stated.

Briefly, if tested, any member of a grouped population must be confirmed according to established acceptance criteria. It is in this spirit that the Chrysler mass-correction procedure is proposed.

Currently, the Chrysler coastdown strategy involves testing the lightest available vehicle in the heaviest ETW class for each submitted vehicle and tire group. This yields a "worst case" (numerically high) horsepower setting and, therefore, enhances confirmation at the lighter weight classes. The proposed Chrysler mass-correction procedure simply extends this strategy to also include a new dynamometer match time estimate at the lighter ETW class. This estimate is based not only on the change to the lighter dynamometer ETW class, but also on a change to the corresponding road test mass representative of this new dynamometer inertia weight setting.

To account for the change in the road test mass associated with the lighter dynamometer ETW class, let us begin with the general definition of the road force on the vehicle and develop it's relationship to the coastdown "target" time.

In E.P.A. Advisory Circular No. 55B (Attachment AI-10, eqn 15) the total force (F^*) on a vehicle at the standard ambient condition is:

$$F^* = f_0^* + f_2^*V^2$$

where f_0^* = weather corrected tire rolling resistance force coefficient

f_2^* = weather corrected aerodynamic drag component force coefficient

Tire rolling resistance has been determined to be directly related to the normal load on the tire. Attachment "A" shows tire rolling resistance test data supplied to Chrysler by Goodyear. The data, obtained on Goodyear's road simulating Rolling Resistance Machine, shows that, after accounting for machine losses, a direct relationship exists between tire load and rolling resistance regardless of tire size. Consequently, a direct correction to the tire rolling resistance force coefficient (f_0^*) can be made to represent vehicles with a road test mass (M_{new}) different from that of the coastdown vehicle (M_{old}). This correction is applied as follows:

Equation stored as CD8610_1.PCX

Note that the proposed Chrysler mass-correction technique applies the mass ratio to the weather corrected rolling resistance force coefficient. Applying the mass ratio to the rolling resistance force coefficient before correcting to standard ambient conditions, however, does not significantly change the result ($f_0^*_{new}$).

The force on a vehicle due to aerodynamic drag is dependent on the velocity squared and is not typically affected by the mass of the vehicle. Consequently, the weather corrected aerodynamic drag component (f_2^*) should remain constant for vehicles (of the same body type) with a road test mass different from that of the coastdown vehicle.

The relationship between the weather corrected force coefficients and the coastdown "target" time is described in E.P.A. Advisory Circular No. 55B (Attachment AI-11, eqn. 19) as follows:

Equation stored as CD8610_2.PCX

where: MD = total effective mass of vehicle-dynamometer system
V1 = 55 MPH
V2 = 45 MPH

The Chrysler mass-corrected coastdown "target" time is then established by substituting the adjusted tire rolling resistance force coefficient (f_{o*new}) and new total effective mass (MD new) into equation (19) as follows:

Equation stored as CD8610_3.PCX

As in Advisory Circular No. 55B, MD new is composed of the new equivalent mass simulated on the dynamometer plus the effective equivalent mass of the drive wheels.

In absolute terms, the best way to describe the proposed Chrysler mass-correction procedure is to follow a step-by-step example. We have selected the 'K' Body (KDP21/41) equipped with P185/70R14 tires from Chrysler's 1987 coastdown submittal for this purpose. The 1987 'K' Body submittal included dynamometer ETW classes of 2750, 2875, and 3000 lbs. These weight classes were covered by a coastdown submittal of 16.18 seconds and 7.3 HP (without A/C) based on tests conducted at the maximum 3000 lb ETW.

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Repeating the proposed Chrysler mass-correction technique a second time with a 1987 KPD21/41 model vehicle at the 2875 ETW yields:

Table stored as CD8610_5.PCX

As stated in E.P.A. Advisory Circular No. 55B (Section II, A), the purpose of the rolls horsepower (DPA) setting is to account for a particular test vehicle's resistance due to atmospheric drag. Therefore, in the 'K' Body example, the "worst case" 7.3 HP DPA setting can be logically extended to also cover the 2750 and 2875 lb test weight classes. The new coastdown submittal for the 'K' Body with P185/70R14 tires would then be as follows:

Table stored as CD8610_6.PCX

In the above example, each configuration is properly represented by coastdown horsepower and time data reflecting its road weight and ETW class.

DEPARTMENT 7860
02/06/86

ATTACHMENT A IS STORED AS:

CD8610_7.PCX THROUGH CD861016.PCX